Centers for Disease Control and Prevention
Epidemiology Program Office
Case Studies in Applied Epidemiology
No. 401-303

Oswego – An Outbreak of Gastrointestinal Illness Following a Church Supper

Instructor's Guide

Learning Objectives
After completing this case study, the participant should be able to:

☐ Define the terms “cluster,” “outbreak,” and “epidemic;”

☐ List the steps in the investigation of an outbreak;

☐ Draw, interpret, and describe the value of an epidemic curve;

☐ Calculate and compare food-specific attack rates to identify possible vehicles;

☐ List reasons for investigating an outbreak that has apparently ended.

This case study is based on an investigation conducted by the New York State Department of Public Health Division. The case study was developed by Wendell Ames, MD, Stafford Wheeler, MD, and Alexander Langmuir, MD in the early 1940s. It has been substantially updated and edited since then by Philip Brachman, Michael Gregg, and Richard Dicker, with input from the many instructors who have reviewed and taught "Oswego" as part of the EIS Summer Course each year.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service

PART I - Background

On April 19, 1940, the local health officer in the village of Lycoming, Oswego County, New York, reported the occurrence of an outbreak of acute gastrointestinal illness to the District Health Officer in Syracuse. Dr. A. M. Rubin, epidemiologist-in-training, was assigned to conduct an investigation.

When Dr. Rubin arrived in the field, he learned from the health officer that all persons known to be ill had attended a church supper held on the previous evening, April 18. Family members who did not attend the church supper did not become ill. Accordingly, Dr. Rubin focused the investigation on the supper. He completed Interviews with 75 of the 80 persons known to have attended, collecting information about the occurrence and time of onset of symptoms, and foods consumed. Of the 75 persons interviewed, 46 persons reported gastrointestinal illness.

Question 1: Would you call this an epidemic? Would you call it an outbreak?

Answer 1

Both epidemic and outbreak are usually defined as the occurrence of more cases in a place (or population) and time than expected. Of the 75 persons interviewed, 46 were ill with gastroenteritis during a 24-hour time period. This is clearly above the "expected" or background rate of gastroenteritis in a community.

The terms "outbreak" and "epidemic" are used interchangeably by many epidemiologists, although some consider the term “outbreak” to refer to a more localized situation, and “epidemic” to refer to a more widespread (and perhaps prolonged) situation. Traditionally, the term “epidemic” has been more frightening to the public than “outbreak,” so most field investigators have used the latter term when talking to the press or public. On the other hand, the term “epidemic” is now at risk of being overused, particularly for social problems to which advocates want to draw public attention and concern.

The term "cluster" may be defined as the occurrence of a group of cases in a circumscribed place and time, in amounts that are thought or suspected (by the public or others) to be greater than expected. The cluster is usually based on anecdotal evidence, and often the first task of the epidemiologist is to determine whether the number of cases truly is or is not be greater than expected.

As noted above, acute illness in 46 out of 75 persons is clearly above expected rates. If the excess were not as obvious, one should compare the rate with some baseline data. For example, we could compare the observed attack rate with National Health Interview Survey data of 2 episodes of diarrheal illness/person/year. For reportable diseases, most health departments compare the number of current cases with the number in a preceding time period or the comparable time period in the previous year or years.

Question 2: Review the steps of an outbreak investigation.

Answer 2

INSTRUCTORS' NOTES:

- There is no single "right" list, but every field epidemiologist ought to have a systematic approach to an outbreak investigation. The benefit of having a list is that, in the heat of the investigation, you will not overlook some critical step.
- The steps are not fixed in order. In some situations, control measures (listed as step 10 below) can and should be implemented immediately. Verification of the diagnosis may come at the same time as verification of an epidemic, or laboratory confirmation may come weeks after the investigation is over.
- Many components are dynamic: case definitions, line listings, descriptive epidemiology, and hypotheses all can (and sometimes should) change with additional information.

Steps of an outbreak investigation:

1. Identify potential investigation team and resources / Prepare for field work (e.g., administration, clearance, travel, contacts, designation of lead investigator, etc.)
2. Establish the existence of an epidemic
3. Verify the diagnosis
4. Construct a working case definition
5. Find cases systematically, develop line listing
6. Perform descriptive epidemiology
7. Develop hypotheses
8. Evaluate hypotheses
9. As necessary, reconsider / refine hypotheses and execute additional studies
10. Implement control and prevention measures (as early as possible)
11. Communicate findings
    - Summarize investigation for requesting authority
    - Prepare written report(s)
12. Maintain surveillance to monitor trends and evaluate control / prevention measures

Clinical Description

The onset of illness in all cases was acute, characterized chiefly by nausea, vomiting, diarrhea, and abdominal pain. None of the ill persons reported having an elevated temperature; all recovered within 24 to 30 hours. Approximately 20% of the ill persons visited physicians. No fecal specimens were obtained for bacteriologic examination.

Question 3: List the broad categories of diseases that must be considered in the differential diagnosis of an outbreak of gastrointestinal illness.

Answer 3

The broad categories include:
- infectious (bacterial, viral, parasitic)
- toxic / environmental
- sociogenic

Instructor's note: Do NOT solicit a more detailed list of possible causes, but it is provided for your information.

Bacteria and bacterial toxins
- **Bacillus cereus*
- *Campylobacter jejuni*
- *Clostridium botulinum* (initial symptoms)
- *Clostridium perfringens*
- *Escherichia coli*
- *Salmonella*, non-typhoid
- *Salmonella typhi*
- *Shigella*
- **Staphylococcus aureus*
- *Vibrio cholerae* 01
- *Vibrio cholerae* non-01
- *Vibrio parahemolyticus*
- *Yersinia enterocolitica*

Viruses
- Norovirus (formerly, "Norwalk-like" agents)
- Rotavirus

Parasites
- *Entamoeba histolytica*
- *Giardia lamblia*
- Cryptosporidium

Toxins
- *Heavy metals (especially cadmium, copper, tin, zinc)
- *Mushrooms
- Fish & shellfish (e.g., scombroid, ciguatera)
- Insecticides
- Drugs
- Boric Acid

Other
- Sociogenic
- Radiation

* most compatible with clinical findings

The investigators suspected that this was a vehicle-borne outbreak, with food as the vehicle.

Question 4: In epidemiologic parlance, what is a vehicle? What is a vector? What are other modes of transmission?

Answer 4

A **vehicle** is an non-living intermediary such as food, water, biologic product, or fomite (inanimate object such as handkerchief, bedding, surgical scalpel, etc.) that conveys the infectious agent from its reservoir to a susceptible host.

A **vector** is a living intermediary, most often an insect or arthropod (such as mosquito, flea, or tick), that conveys the infectious agent from its reservoir to a susceptible host. Transmission may be either mechanical (i.e., the agent does not multiply or undergo physiologic changes in the vector, such as flies carrying *Shigella* on their appendages) or biological (i.e., the agent undergoes part of its life cycle inside the vector before being transmitted to a new host).

Transmission of an infectious agent occurs when the agent leaves its reservoir or host though a portal of exit, is conveyed by some mode of transmission, and enters through an appropriate portal of entry to infect a susceptible host.

The **reservoir** of an agent is the habitat in which an infectious agent normally lives, grows, and multiplies. Reservoirs for GI agents include humans (*S. typhi*), animals (*Campylobacter*, *Giardia*), and the environment (*Clostridium botulinum*).

Modes of transmission from the reservoir to the susceptible host may be classified as:

- Direct
  - Direct contact = direct exposure to a person or animal or its waste products, so includes mucous membrane to mucous membrane (STDs), skin-to-skin (herpes type I, anthrax from direct contact with infected animal), across placenta (toxoplasmosis), fecal-oral, ingestion of infected food (trichinosis).
  - Droplet spread, e.g., sneezes, coughs
- Indirect
  - airborne = organisms truly suspended in air (Legionnaire's disease)
  - vehicleborne = where food, water, or fomite acts as conveyance
  - vectorborne = transmitted by arthropod (e.g., West Nile virus encephalitis)

Modes or portals entry include ingestion (most common for GI illnesses), inhalation, percutaneous, parenteral, etc.

Question 5: If you were to administer a questionnaire to the church supper participants, what information would you collect? Group the information into categories.

Answer 5

1. IDENTIFYING INFORMATION
   - name, address, phone number
   - respondent (e.g., self, parent of child, spouse)
2. DEMOGRAPHIC INFORMATION
   - birth date or age
   - sex
   - occupation (?)
3. CLINICAL INFORMATION
   - signs/symptoms, severity or outcome (hospitalization, death), time of onset, duration
   - documented medical care [name & phone number if you need to contact doc])
   - pre-existing medical conditions, medications (especially antibiotics, antacids), etc.
4. EPIDEMIOLOGY (especially RISK FACTOR) INFORMATION (exposures and contacts), including:
   - what was eaten at picnic, how much, when
   - foods eaten before and after picnic (but before illness)
   - activities (other than picnic) that respondents may have participated in
   - contacts with ill persons (others ill in family?)
   - role in food preparation, handling
5. ABSTRACTOR / INTERVIEWER INFORMATION

[6. In some situations, you might want to collect information on people this case may have exposed, e.g., sexual contacts.]

Dr. Rubin put his data into a line listing.

Question 6: What is a line listing? What is the value of a line listing?

Answer 6

A line listing is a grid containing information about persons who are the subject of an investigation. It looks much like a spreadsheet, with rows and columns. Each row represents data for a single case. Each column represents a variable such as name (or initials or ID number), phone number, age, date of onset, or other important identifying information, clinical details such as lab confirmation, descriptive epidemiology factors, or exposures / potential risk factors. The line listing may be compiled by hand or generated from a computer database.

The importance of a good line listing cannot be overstated, particularly in the early phase of an investigation before a questionnaire has been developed and tested. It provides a log of possible and confirmed cases identified to date. At a glance one can see which cases have been interviewed and which have not. It is an efficient way to display the key data elements that all members of an investigating team can see. It is also an efficient way to review the key data elements -- to scan the columns for common responses, outliers, missing data, and the like. Even in the era of computers, many field epidemiologists maintain a written line listing with names and a small number of critical variables. (You don't have to worry about paper line lists getting viruses and/or crashing and/or battery running down.).

PART II

Description of the Supper

The supper was held in the basement of the village church. Foods were contributed by numerous members of the congregation. The supper began at 6:00 p.m. and continued until 11:00 p.m. Food was spread out on a table and consumed over a period of several hours.

Data regarding onset of illness and food eaten or water drunk by each of the 75 persons interviewed are provided in the attached line listing. The approximate time of eating supper was collected for only about half the persons who had gastrointestinal illness.

Question 7: What is the value of an epidemic curve?

Answer 7

An epidemic curve, or epi curve for short, is a two-dimensional graph that provides a simple visual display of an epidemic's magnitude and time course. The epidemic curve has time along the X-axis and number of cases along the Y-axis. Because time is continuous, the epidemic curve is drawn as a **histogram** (no gaps between adjacent columns), not as a bar chart.

The units of time must be consistent along the length of the X-axis; for example, 1/4" must equal 1 day anywhere along the X-axis. For a given graph, the most appropriate units of time for the X-axis depend on the incubation period of the disease, the length of time over which cases are distributed, and the points you wish to communicate with the graph. One rule of thumb states that the units should be between one-eighth to one-third (e.g., roughly one-quarter) as long as the incubation period of the disease in question. So for a common source outbreak of *Clostridium perfringens* gastroenteritis (usual incubation period 10-12 hours), X-axis units of 2-3 hours would be suitable.

If data are available from the pre-epidemic period, the X-axis should begin well before the onset of the epidemic. The pre-epidemic period illustrates the background or usual number of cases and, for a disease with a human host like hepatitis A, may include the source case of the epidemic.

An epidemic curve is most visually appealing if the length of the unit intervals on the X- and Y-axes are equal. Thus, one case in a time interval is represented by a square. Some but not all epidemiologists draw horizontal lines in the columns to form what looks like a stack of boxes. Usually, each box represents a single case. For an epidemic with a large number of cases, each box may be drawn to represent 5 or 10 or even more cases. If boxes are used, a legend should be included that shows how many cases the box represents.

ANSWER 7 CONTINUED ON NEXT PAGE

Answer 7 continued

Epidemic curves are a basic tool of field epidemiologists because they can be highly informative:

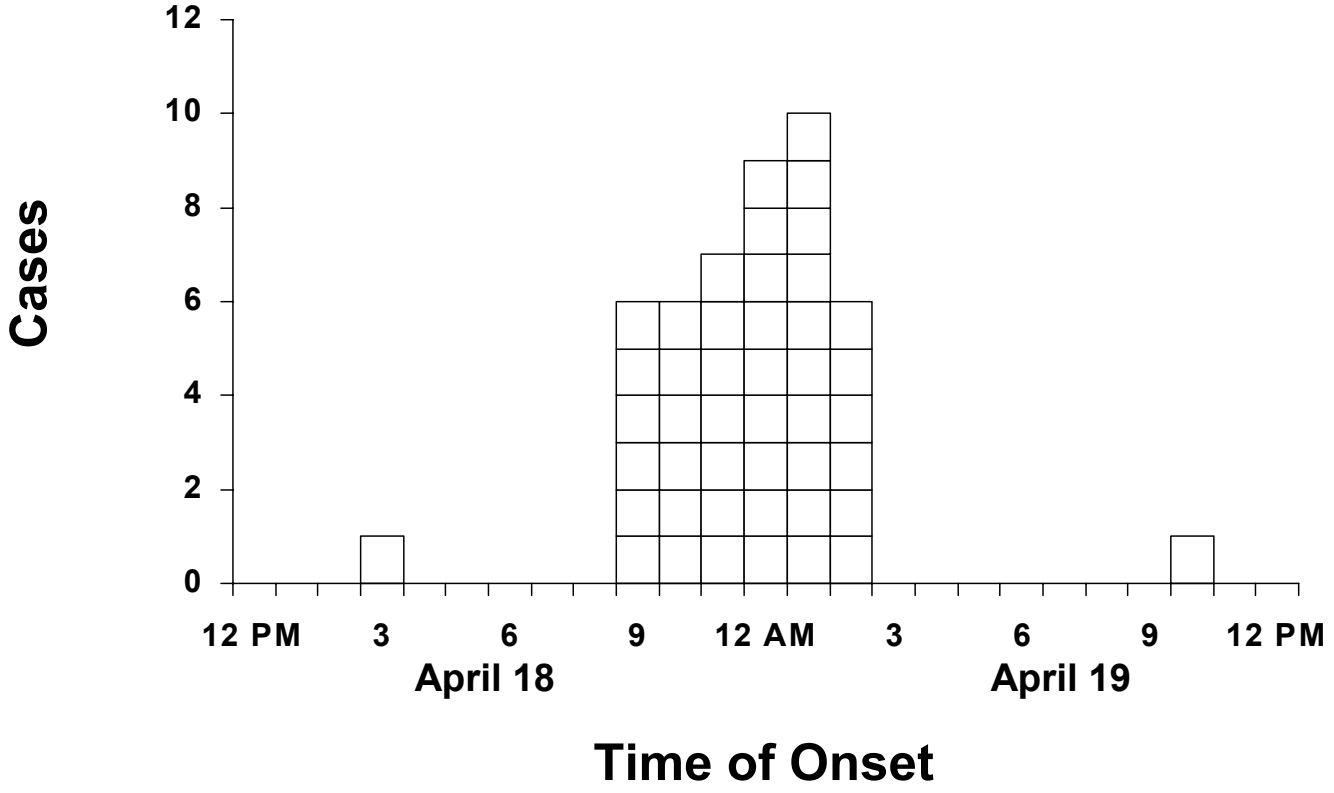
- The epi curve shows the magnitude of the epidemic over time as a simple, easily understand visual. It can distinguish epidemic from endemic disease. Potentially correlated events can be noted on the graph.
- The shape of the epidemic curve may provide clues to the pattern of spread in the population (e.g., point versus intermittent source versus propagated). (Note, however, that changing the interval on the x-axis can substantially alter the shape of the curve).
- The curve shows where we are in the course of the epidemic - still on the upswing, on the downslope, or after the epidemic has ended. This information forms the basis for predicting whether more or fewer cases will occur in the next time interval.
- The curve can be used for evaluation - how long did it take for the health dept. to identify a problem; are the intervention measures working?
- Outliers -- cases that don't fit into the body of the curve -- are easily recognized. These outliers may provide important leads. An early case may represent a background or unrelated case, a source of the epidemic, or a person who was exposed earlier than most of the cases (for example, the cook who tasted her dish hours before bringing it to the big picnic.) Similarly, late cases may represent unrelated cases, long-incubation-period cases, secondary cases, or persons exposed later than most others. These outliers are worth examining carefully because if they are part of the outbreak, their unusual exposures may point directly to the source.

Question 8: Using the graph paper provided, graph the cases by time of onset of illness (include appropriate labels and title). What does this graph tell you?

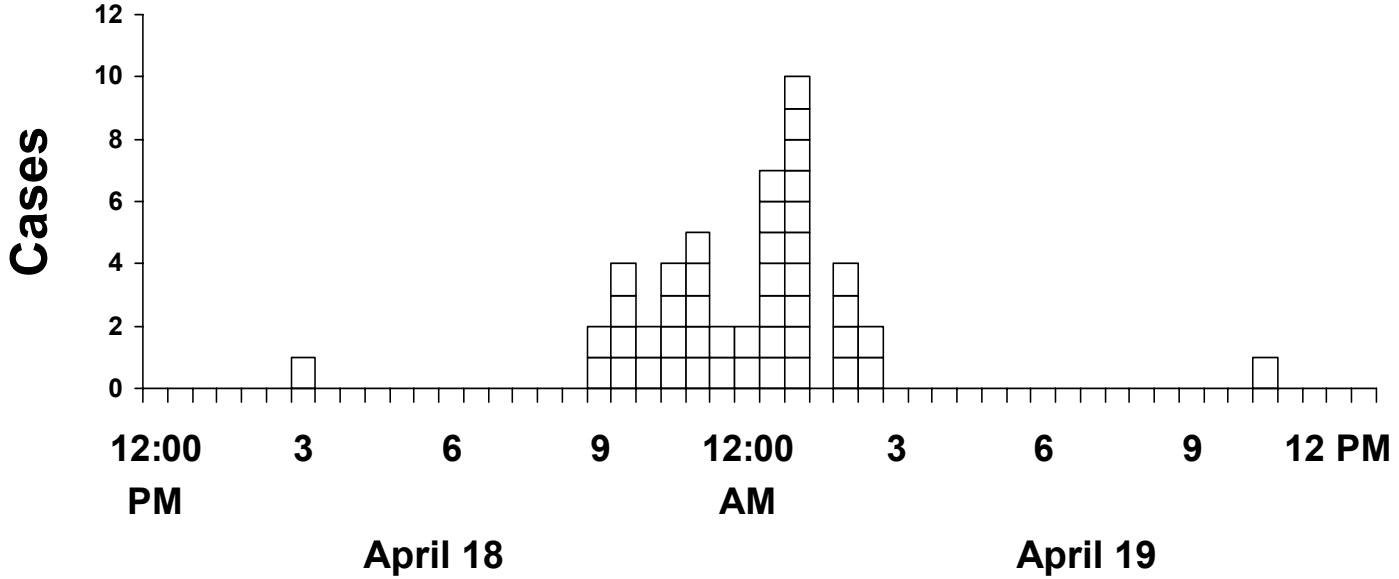
Answer 8

See graph next page. The graph has several obvious features – other than one very early case and one very late case, all other cases are clustered tightly within a six-hour interval. The tight clustering around a single peak is very consistent with a point source (common exposure over a short period of time) outbreak.

Cases of Gastrointestinal Illness by Time of Onset of Symptoms (Hour Categories) Oswego County, New York, April 18-19, 1940



Cases of Gastrointestinal Illness
by Time of Onset of Symptoms (1/2 Hour Categories)
Oswego County, New York, April 18-19, 1940



Question 9: Are there any cases for which the times of onset are inconsistent with the general experience? How might they be explained?

Answer 9

Two Inconsistent Cases:

Subject #52 - 8-year-old boy who ate early (11 a.m.). Incubation period typical (4 hours). Illness not related to outbreak? Was he the cook's son? Suggests that vehicle was already prepared and contaminated by 11 a.m.

Subject #16 - 32-year-old woman. Did she have a long incubation period (don't know when she ate)? Vehicle taken home and eaten later? Unrelated illness? Data incorrect (error by interviewer or interviewee)? Computer coding error? Secondary case?

(You should resist the temptation to change data just because you think they are in error.)

Question 10: How could the data in the line listing be better presented?

Answer 10

The line listing could be improved by separating ill from non-ill persons, and sorting by time of onset. Military time, e.g., 2200 hrs. for 10 p.m., is preferred in many other countries.

Line listing from investigation of outbreak of gastroenteritis,
Oswego, New York, 1940

ID	AGE	SEX	TIME OF MEAL	ILL	DATE OF ONSET	TIME OF ONSET	Baked ham	Spinach	Mashed potatoes	Cabbage salad	Jello	Rolls	Brown bread	Milk	Coffee	Water	Cakes	Van ice cream	Choc ice cream	Fruit salad
1	11	M	unk	N			N	N	N	N	N	N	N	N	N	N	N	N	Y	N
2	52	F	8:00 PM	Y	4/19	12:30 AM	Y	Y	Y	N	N	Y	N	N	Y	N	N	Y	N	N
3	65	M	6:30 PM	Y	4/19	12:30 AM	Y	Y	Y	Y	N	N	N	N	Y	N	N	Y	Y	N
4	59	F	6:30 PM	Y	4/19	12:30 AM	Y	Y	N	N	N	N	N	N	Y	N	Y	Y	Y	N
5	13	F	unk	N			N	N	N	N	N	N	N	N	N	N	N	N	Y	N
6	63	F	7:30 PM	Y	4/18	10:30 PM	Y	Y	N	Y	Y	N	N	N	N	Y	N	Y	N	N
7	70	M	7:30 PM	Y	4/18	10:30 PM	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y	N	N
8	40	F	7:30 PM	Y	4/19	2:00 AM	N	N	N	N	N	N	N	N	N	N	N	Y	Y	N
9	15	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N
10	33	F	7:00 PM	Y	4/18	11:00 PM	Y	Y	Y	N	N	Y	Y	N	N	Y	N	Y	Y	N
11	65	M	unk	N			Y	Y	Y	N	Y	Y	N	N	N	N	N	Y	N	N
12	38	F	unk	N			Y	Y	Y	N	N	Y	N	N	Y	N	N	Y	Y	Y
13	62	F	unk	N			Y	Y	N	Y	Y	Y	Y	N	N	Y	N	N	N	N
14	10	M	7:30 PM	Y	4/19	2:00 AM	N	N	N	N	N	N	N	N	N	N	N	Y	Y	N
15	25	M	unk	N			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
16	32	F	unk	Y	4/19	10:30 AM	Y	Y	N	N	N	Y	N	N	Y	N	Y	Y	Y	N
17	62	F	unk	Y	4/19	12:30 AM	N	N	N	N	N	N	N	N	N	N	N	Y	N	N
18	36	M	unk	Y	4/18	10:15 PM	Y	Y	N	Y	N	Y	Y	N	N	N	N	Y	N	N
19	11	M	unk	N			Y	Y	?	Y	N	Y	N	N	N	Y	N	N	Y	N
20	33	F	unk	Y	4/18	10:00 PM	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	N
21	13	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N
22	7	M	unk	Y	4/18	11:00 PM	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N
23	64	M	unk	N			N	N	N	N	N	N	N	N	N	N	N	Y	N	N
24	3	M	unk	Y	4/18	9:45 PM	N	Y	Y	N	N	Y	N	N	N	Y	Y	Y	N	N
25	65	F	unk	N			Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	Y	N
26	59	F	unk	Y	4/18	9:45 PM	N	Y	Y	Y	N	Y	Y	N	N	Y	Y	Y	N	N
27	15	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N
28	62	M	unk	N			Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	N
29	37	F	unk	Y	4/18	11:00 PM	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	N
30	17	M	10:00 PM	N			N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N
31	35	M	unk	Y	4/18	9:00 PM	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y
32	15	M	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N
33	50	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	N	Y	N	N
34	40	M	unk	N			Y	Y	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y
35	35	F	unk	N			Y	Y	Y	N	N	Y	Y	N	Y	Y	N	N	Y	N
36	35	F	unk	Y	4/18	9:15 PM	Y	Y	Y	Y	N	Y	Y	N	Y	N	N	Y	N	N
37	36	M	unk	N			Y	N	Y	Y	N	Y	Y	N	Y	N	N	N	Y	N
38	57	F	unk	Y	4/18	11:30 PM	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N
39	16	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N
40	68	M	unk	Y	4/18	9:30 PM	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	N	N

Line listing from investigation of outbreak of gastroenteritis,
Oswego, New York, 1940

ID	AGE	SEX	TIME OF MEAL	ILL	DATE OF ONSET	TIME OF ONSET	Baked ham	Spinach	Mashed potatoes	Cabbage salad	Jello	Rolls	Brown bread	Milk	Coffee	Water	Cakes	Van ice cream	Choc ice cream	Fruit salad
41	54	F	unk	N			Y	Y	Y	N	N	Y	N	N	Y	N	Y	N	Y	N
42	77	M	unk	Y	4/19	2:30 AM	N	N	N	N	N	N	N	N	N	N	N	Y	N	Y
43	72	F	unk	Y	4/19	2:00 AM	Y	Y	N	Y	Y	N	Y	N	Y	N	Y	Y	Y	N
44	58	M	unk	Y	4/18	9:30 PM	Y	Y	Y	N	N	N	Y	Y	Y	N	N	Y	?	Y
45	20	M	10:00 PM	N			N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N
46	17	M	unk	N			Y	Y	Y	N	N	Y	N	N	N	Y	N	Y	Y	N
47	62	F	unk	Y	4/19	12:30 AM	Y	Y	N	N	N	Y	N	N	N	Y	N	Y	N	N
48	20	F	7:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	N	Y	N	N
49	52	F	unk	Y	4/18	10:30 PM	Y	Y	Y	Y	N	Y	N	N	Y	N	N	Y	Y	N
50	9	F	unk	N			N	N	N	N	N	N	N	N	N	N	Y	N	Y	N
51	50	M	unk	N			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N
52	8	M	11:00 AM	Y	4/18	3:00 PM	N	N	N	N	N	N	N	N	N	N	N	Y	Y	N
53	35	F	unk	N			N	N	N	N	N	N	N	N	N	N	N	Y	Y	N
54	48	F	unk	Y	4/19	12:00 AM*	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N
55	25	M	unk	Y	4/18	11:00 PM	Y	N	Y	N	N	Y	Y	N	N	Y	Y	Y	Y	N
56	11	F	unk	N			N	N	N	N	N	N	N	N	N	N	N	N	Y	N
57	74	M	unk	Y	4/18	10:30 PM	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	N
58	12	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N
59	44	F	7:30 PM	Y	4/19	2:30 AM	Y	Y	Y	N	N	Y	N	N	N	Y	Y	N	Y	N
60	53	F	7:30 PM	Y	4/18	11:30 PM	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N
61	37	M	unk	N			N	N	N	N	N	N	N	N	N	N	N	N	Y	N
62	24	F	unk	N			Y	Y	Y	N	N	Y	N	N	Y	N	N	N	N	N
63	69	F	unk	N			N	Y	Y	N	Y	N	Y	N	N	Y	Y	N	Y	N
64	7	M	unk	N			Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	N	Y	N
65	17	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	Y	Y	Y	N	
66	8	F	unk	Y	4/19	12:30 AM	Y	N	Y	Y	Y	N	N	N	N	N	Y	Y	Y	N
67	11	F	7:30 PM	N			Y	Y	Y	Y	N	Y	N	N	Y	Y	N	N	Y	N
68	17	M	7:30 PM	N			Y	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	N	N
69	36	F	unk	N			N	N	N	N	N	N	N	N	N	N	N	N	Y	N
70	21	F	unk	Y	4/19	12:30 AM	Y	N	N	Y	Y	N	N	N	N	N	N	Y	Y	N
71	60	M	7:30 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N
72	18	F	7:30 PM	Y	4/19	12:00 AM*	Y	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	N
73	14	F	10:00 PM	N			N	N	N	N	N	N	N	N	N	N	Y	Y	N	N
74	52	M	unk	Y	4/19	2:15 AM	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N
75	45	F	unk	Y	4/18	11:00 PM	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y

* Midnight between 4/18 and 4/19

INSTRUCTORS: Take a break before proceeding to Part III. During the break, draw grid for question 14 on the blackboard (unless you plan to use an overhead)! Then hand out Oswego Part III and the Compendium of Acute Foodborne Gastrointestinal Diseases.

PART III

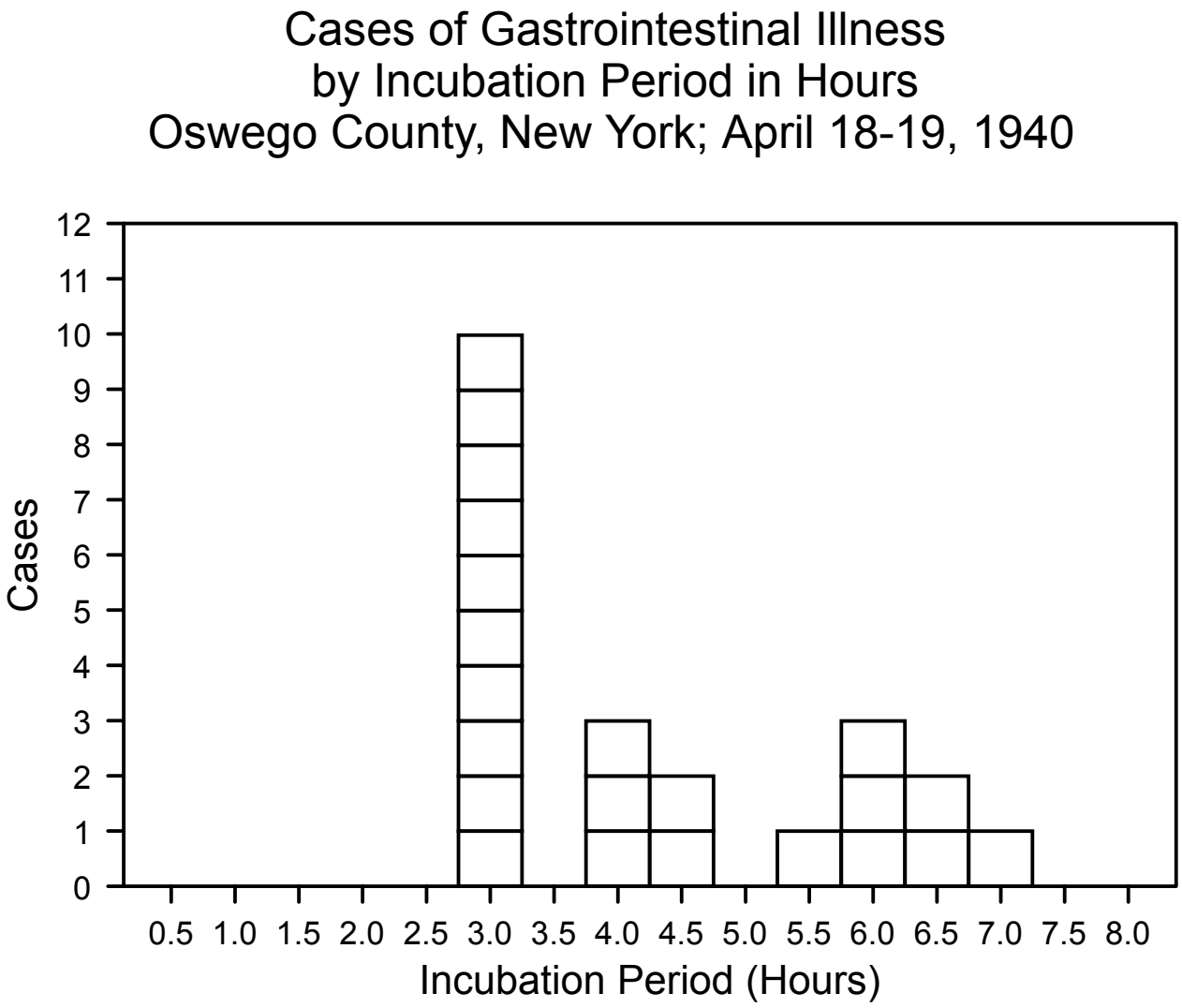
Attached is the line listing sorted by illness status (ill or well), and by time of onset.

Question 11: Where possible, using the new line listing, calculate incubation periods and illustrate their distribution with an appropriate graph.

Answer 11
See graph next page.

The graph of incubation periods is not symmetric or normally distributed, but biphasic when graphed by 1-hour intervals. The incubation period was shorter for those eating later (median 5 l/2 hours for those eating from 6 to 8 p.m. and median 3 hours for those eating after 9 p.m.) which tends to concentrate the peak. This could be explained by continuing enterotoxin production in the food over the course of the evening, so that those who ate later got a higher dose. However, it could also be due to ingestion of larger amounts by those eating later, who tended to be younger and perhaps more voracious (median age 15 years for those eating after 9 PM and 42 years for those eating from 6 to 8 PM). The attack rate was not significantly different for those eating before 8 p.m. (12/14 ill) than for those eating later (9/12 ill) but time of eating was recorded for only 5 non-ill persons, which makes these data inadequate for time-specific attack rates.

Note that only 22 of the 46 case-patients provided enough information to calculate incubation periods.



Question 12: Determine the range and median of the incubation period.

Answer 12

Instructor's Note: Epidemiologists usually think of a range as two numbers -- the minimum and the maximum. Biostatisticians think of a range as one number -- the difference between the maximum and the minimum.

Range: Minimum = 3 hrs, maximum = 7 hours, range = 4 hours.
Median (11th/12th of 22 cases) = 4 hours.

Question 13: How does the information on incubation period, combined with the data on clinical symptoms, help in the differential diagnosis of the illness? (If necessary, refer to attached Compendium of Acute Foodborne Gastrointestinal Disease).

Answer 13

In general, each cause of foodborne disease has a characteristic incubation period, a characteristic constellation of symptoms, and foods with which it is most commonly associated. By comparing the incubation period and reported symptoms to the Compendium, one can narrow the list of potential causes considerably. For example, in general, short incubation periods (#6 hours) are typical of diseases caused by chemicals or preformed bacterial toxins, while longer incubation periods occur when the disease results from *in vivo* toxin production, microbial growth, or tissue invasion.

The observed incubation period (3-7 hours, with median of 4) is too long for heavy metals and too short for viral agents and botulism. It is consistent with the incubation period for fish toxins, some of the toxic mushrooms, *S. aureus* enterotoxin, and the short-incubation syndrome caused by *B. cereus*. The fish toxins can be eliminated by lack of the characteristic symptoms -- Ciguatera usually results in striking sensory symptoms, and scombroid in a bright red flushed face. Mushrooms would be a possibility if they were served in, say, the cabbage salad. *B. cereus* is almost exclusively transmitted by leftover rice, but no rice was reported. Therefore, the most likely cause is probably *S. aureus* poisoning; with *B. cereus* and mushroom poisoning as possibilities of either rice or mushrooms were served.

Question 14: Using the data in the attached line listing, complete the table below. Which food is the most likely vehicle of infection?

Food Items Served	Number of persons who ATE specified food				Number of persons did NOT eat specified food				Attack Rate Ratio
	Ill	Not Ill	Total	Percent Ill (Attack rate)	Ill	Not Ill	Total	Percent Ill (Attack rate)	
Baked ham									
Spinach									
Mashed potato									
Cabbage salad									
Jello									
Rolls									
Brown bread									
Milk									
Coffee									
Water									
Cakes									
Ice cream, vanilla									
Ice cream, chocolate									
Fruit salad									

Answer 14

INSTRUCTOR'S NOTE: Break the class into groups of 2-4, and assign 2-4 food items (there are 14 items) to each group.

The appropriate analysis in this setting is a retrospective cohort analysis, because we have information on the entire population (almost), and we can calculate rates. Many students will want to analyze these data in case-control fashion; while this is not wrong, it is less desirable. As a general rule, if you can calculate rates, you should do so.

Using the retrospective cohort approach, calculate food specific attack rates for each food. The true vehicle is likely to have three features:

1. The attack rate is high among persons who ate the food (high food-specific attack rate).
2. The attack rate is low among persons who did not eat the food (so the difference or ratio is high).
3. Most of the cases were exposed, so the exposure could "explain" most, if not all, of the cases.

Students should (split the tasks up):

1. Construct food-specific attack rate table (see next page).
2. Look for foods with a high attack rate ("risk") among those exposed, and a low attack rate among those not exposed.
   - One could compute a ratio of attack rates between eaters and non-eaters for each food item ("attack rate ratio" or "risk ratio"). (Less commonly done, one could compute the difference in ratios instead.) These are measures of association between exposure (food) and disease. One would then look for foods with high ratios or differences.
3. Determine whether any foods identified in step 2 can account for most of the cases.
4. Optionally, could construct a 2-by-2 table.

	Ill	Well	Total	Attack rate	Rate ratio
Ate food A	a	b	a+b	a / a+b	$\frac{a / a+b}{c / c+d}$
Did not eat food A	c	d	c+d	c / c+ d	
Total	a+c	b+d	t = (a+b+c+d)		

5a. Optionally (but don't encourage), one could calculate a Chi-square to determine whether the association is "statistically significant" (X^2 $ 3.84 corresponds to p-value # 0.05):

$$X^2 = \frac{t(*ad-bc*-t/2)^2}{(a + b)(c + d)(a + c)(b + d)}$$

5b. Optionally (but don't encourage), one could calculate a confidence interval as a measure of the precision of the risk ratio (sometimes also used as surrogate for statistical significance test).

$$95\%CI = RR \times \exp(\pm 1.96/W), \text{ where } W = \sqrt{\frac{acN_1N_0}{adN_1 + bcN_0}}$$

Answer 14 continued on next page

Answer 14 continued

Food Items Served	Number of persons who ATE specified food				Number of persons did NOT eat specified food				Attack Rate Ratio
	Ill	Not Ill	Total	Percent Ill (Attack rate)	Ill	Not Ill	Total	Percent Ill (Attack rate)	
Baked ham	29	17	46	63%	17	12	29	59%	1.1
Spinach	26	17	43	60%	20	12	32	62%	1.0
Mashed potato*	23	14	37	62%	23	14	37	62%	1.0
Cabbage salad	18	10	28	64%	28	19	47	60%	1.1
Jello	16	7	23	70%	30	22	52	58%	1.2
Rolls	21	16	37	57%	25	13	38	66%	0.8
Brown bread	18	9	27	67%	28	20	48	58%	1.0
Milk	2	2	4	50%	44	27	71	62%	0.8
Coffee	19	12	31	61%	27	17	44	61%	1.0
Water	13	11	24	54%	33	18	51	65%	0.8
Cakes	27	13	40	67%	19	16	35	54%	1.3
Ice cream, vanilla	43	11	54	80%	3	18	21	14%	5.7
Ice cream, chocolate*	25	22	47	53%	20	7	27	74%	0.7
Fruit salad	4	2	6	67%	42	27	69	61%	1.1

* Excludes 1 person with indefinite history of consumption of that food.

1. Food with highest attack rate among consumers: vanilla ice cream (80%)
2. Food with lowest attack rate among non-consumers: vanilla ice cream (14%)
3. Proportion of cases exposed to vanilla ice cream: 43/46 = 93%.

	Ill	Well	Total	Attack Rate
Ate vanilla ice cream	43	11	54	79.6%
Did not eat	3	18	21	14.3%
Total	46	29	75	61.3%

The attack rate ratio, also called the relative risk, can be calculated as 79.6%/14.3% = 5.6. This difference in attack rates is highly statistically significant by Yates-corrected chi square. Chi square = 24.5, with 1 degrees of freedom, $p = 7 \times 10^{-7}$. Taylor-series 95% confidence limits = 1.9 and 16.0.

Answer 14 continued on next page

Answer 14 continued
Optional teaching points:

1. Three ill persons denied eating vanilla ice cream (all 3 ate cake and chocolate ice cream) Imperfect memory? Multiple vehicles? Cross-contamination between foods via dishes, spoons, servers? Unrelated cases?

2. What could explain other correlations?
   a. Cake weakly correlated (RR=1.3). Does this reflect:
      1) An association due to preference for cake and ice cream?
      2) Independent or cross-contamination of cake?
      3) Chance?
   b. Chocolate ice cream negatively correlated (RR=0.7), because 25 persons who ate vanilla ice cream only (with an attack rate of 80.0%) are in the comparison group.

3. Limitations of any retrospective investigation:
   a. Poor recall on the part of study subjects.
   b. Interview subjects may not understand interview form or questions.
   c. Unrelated illnesses may cause unexposed to be counted as cases.
   d. Food handlers may conceal facts due to guilt, real or imagined.
   e. Well people are apt to remember less well and answer less completely; they may be questioned differently by the interviewer.

Epidemiologic evidence shows an association, does not prove causal relationship.

Question 15: Outline further investigations that should be pursued.

Answer 15
Many further investigations could be pursued, but constraints on resources and time must be considered. Among actions that should be pursued are:

A. Detailed review of source, ingredients, preparation, and storage of incriminated food. For bacterial food poisoning need (I) initial contamination event e.g., raw milk, or by food handler, and (2) time-temperature abuse in preparation/storage. The latter may be more easily controlled in the case of *S. aureus*. Take a food sanitarian to investigate.

Among actions that could be pursued are:

B. Try to explain cases with atypical time of onset.
C. Microbiology (very limited availability in 1940, but available now): Laboratory examination could be done of:
   1. Ice cream, with gram stain and culture and phage-typing of *S. aureus*. Enterotoxin assay is done by immunologic techniques (FDA)
   2. Cases. Culture stool (15% - 30% of normals positive for staph) and vomitus; phage type *S. aureus*.
   3. Food handlers (who are sometimes also victims). Culture their noses (30% - 50% of normals positive), skin lesions (relatively rare), and normal skin on hands or wrists (15% - 40% of normals positive) and phage type staph.
D. Determine if secondary spread in family members (would not expect it for staph.)
E. Additional calculations, such as age-specific attack rates (72% in those <40, 88% in older persons who ate vanilla ice cream) and sex-specific attack rates (70% in males, 87% in females).

Question 16: What control measures would you suggest?

Answer 16
Ascertain whether a commercial product is involved. Prevent consumption of remaining vanilla ice cream. Throw it away after analyzing samples and be sure no one has taken any home. Prevent recurrence of similar events in future by educating food handlers in proper techniques, treating *S. aureus* skin lesions, stressing need for refrigeration. When applicable, eliminate contaminated sources of food.

Question 17: Why was it important to work up this outbreak?

Answer 17
A. Rule out contamination of a commercial product (Prompt intervention may prevent thousands of further cases).
B. "An outbreak represents a breakdown in the public health system." Prevent future outbreaks by identifying infected food handler, specific gap in education or food handling techniques.
C. Public health officials need to be "responsibly responsive," i.e., they need to respond to a community problem in order to maintain a cooperative relationship with local health departments, private physicians, and the communities.
D. An epidemiologically- and biologically-based explanation of the cause of the outbreak may allay community fears and concerns that the outbreak was caused by something else (e.g., terrorists, toxic waste.)
E. "Every outbreak is an experiment of nature." The outbreak may provide opportunities for investigators to answer questions about the agent, host response, epidemiologic and laboratory methods, etc.

Question 18: Refer to the steps of an outbreak investigation you listed in Question 2. How does this investigation fit that outline?

Answer 18
The most obvious omission is construction of a case definition. This may have been done in the investigation, but has not been noted in this case study.

The case study does not describe the descriptive epidemiology well either. Descriptive epidemiology includes time, place, and person. Time was characterized by the epidemic curve. But the case study did not ask us to characterize the outbreak by person, e.g., by age and sex, with appropriate denominators.

Line listing from investigation of outbreak of gastroenteritis,
Oswego, New York, 1940

ID	AGE	SEX	TIME OF MEAL	ILL	DATE OF ONSET	TIME OF ONSET	Baked ham	Spinach	Mashed potatoes	Cabbage salad	Jell-O	Rolls	Brown bread	Milk	Coffee	Water	Cakes	Van ice cream	Choc ice cream	Fruit salad
52	8	M	11:00 AM	Y	4/18	3:00 PM	N	N	N	N	N	N	N	N	N	N	N	Y	Y	N
31	35	M	unk	Y	4/18	9:00 PM	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	Y
36	35	F	unk	Y	4/18	9:15 PM	Y	Y	Y	Y	N	Y	Y	N	Y	N	N	Y	N	N
40	68	M	unk	Y	4/18	9:30 PM	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	N	N
44	58	M	unk	Y	4/18	9:30 PM	Y	Y	Y	N	N	N	Y	Y	Y	N	N	Y	?	Y
24	3	M	unk	Y	4/18	9:45 PM	N	Y	Y	N	N	Y	N	N	N	Y	Y	Y	N	N
26	59	F	unk	Y	4/18	9:45 PM	N	Y	Y	Y	N	Y	Y	N	N	Y	Y	Y	N	N
20	33	F	unk	Y	4/18	10:00 PM	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	Y	N
18	36	M	unk	Y	4/18	10:15 PM	Y	Y	N	Y	N	Y	Y	N	N	N	N	Y	N	N
6	63	F	7:30 PM	Y	4/18	10:30 PM	Y	Y	N	Y	Y	N	N	N	N	Y	N	Y	N	N
7	70	M	7:30 PM	Y	4/18	10:30 PM	Y	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y	N	N
49	52	F	unk	Y	4/18	10:30 PM	Y	Y	Y	Y	N	Y	N	N	Y	N	N	Y	Y	N
57	74	M	unk	Y	4/18	10:30 PM	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	N
10	33	F	7:00 PM	Y	4/18	11:00 PM	Y	Y	Y	N	N	Y	Y	N	N	Y	N	Y	Y	N
22	7	M	unk	Y	4/18	11:00 PM	Y	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y	N
29	37	F	unk	Y	4/18	11:00 PM	Y	Y	Y	N	Y	Y	Y	N	Y	N	Y	Y	N	N
55	25	M	unk	Y	4/18	11:00 PM	Y	N	Y	N	N	Y	Y	N	N	Y	Y	Y	Y	N
75	45	F	unk	Y	4/18	11:00 PM	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	N	Y
38	57	F	unk	Y	4/18	11:30 PM	Y	Y	N	Y	Y	Y	Y	N	Y	N	Y	Y	Y	N
60	53	F	7:30 PM	Y	4/18	11:30 PM	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	Y	Y	N
72	18	F	7:30 PM	Y	4/19	12:00 AM*	Y	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	N
54	48	F	unk	Y	4/19	12:00 AM*	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N
2	52	F	8:00 PM	Y	4/19	12:30 AM	Y	Y	Y	N	N	Y	N	N	Y	N	N	Y	N	N
3	65	M	6:30 PM	Y	4/19	12:30 AM	Y	Y	Y	Y	N	N	N	N	Y	N	N	Y	Y	N
4	59	F	6:30 PM	Y	4/19	12:30 AM	Y	Y	N	N	N	N	N	N	Y	N	Y	Y	Y	N
17	62	F	unk	Y	4/19	12:30 AM	N	N	N	N	N	N	N	N	N	N	N	Y	N	N
47	62	F	unk	Y	4/19	12:30 AM	Y	Y	N	N	N	Y	N	N	N	Y	N	Y	N	N
66	8	F	unk	Y	4/19	12:30 AM	Y	N	Y	Y	Y	N	N	N	N	N	Y	Y	Y	N
70	21	F	unk	Y	4/19	12:30 AM	Y	N	N	Y	Y	N	N	N	N	N	N	Y	Y	N
71	60	M	7:30 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N
21	13	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N
27	15	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N
32	15	M	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	Y	N	N
33	50	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	N	Y	N	N
39	16	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N
9	15	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	N	Y	N
48	20	F	7:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	N	Y	N	N
58	12	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N
65	17	F	10:00 PM	Y	4/19	1:00 AM	N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N
8	40	F	7:30 PM	Y	4/19	2:00 AM	N	N	N	N	N	N	N	N	N	N	N	Y	Y	N
14	10	M	7:30 PM	Y	4/19	2:00 AM	N	N	N	N	N	N	N	N	N	N	N	Y	Y	N
43	72	F	unk	Y	4/19	2:00 AM	Y	Y	N	Y	Y	N	Y	N	Y	N	Y	Y	Y	N
74	52	M	unk	Y	4/19	2:15 AM	Y	N	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N
42	77	M	unk	Y	4/19	2:30 AM	N	N	N	N	N	N	N	N	N	N	N	Y	N	Y
59	44	F	7:30 PM	Y	4/19	2:30 AM	Y	Y	Y	N	N	Y	N	N	N	Y	Y	N	Y	N
16	32	F	unk	Y	4/19	10:30 AM	Y	Y	N	N	N	Y	N	N	Y	N	Y	Y	Y	N

* Midnight between 4/18 and 4/19

Line listing from investigation of outbreak of gastroenteritis,
Oswego, New York, 1940

ID	AGE	SEX	TIME OF MEAL	ILL	DATE OF ONSET	TIME OF ONSET	Baked ham	Spinach	Mashed potatoes	Cabbage salad	Jell-O	Rolls	Brown bread	Milk	Coffee	Water	Cakes	Van ice cream	Choc ice cream	Fruit salad
1	11	M	unk	N			N	N	N	N	N	N	N	N	N	N	N	N	Y	N
5	13	F	unk	N			N	N	N	N	N	N	N	N	N	N	N	N	Y	N
11	65	M	unk	N			Y	Y	Y	N	Y	Y	N	N	N	N	N	Y	N	N
12	38	F	unk	N			Y	Y	Y	N	N	Y	N	N	Y	N	N	Y	Y	Y
13	62	F	unk	N			Y	Y	N	Y	Y	Y	Y	N	N	Y	N	N	N	N
15	25	M	unk	N			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
19	11	M	unk	N			Y	Y	?	Y	N	Y	N	N	N	Y	N	N	Y	N
23	64	M	unk	N			N	N	N	N	N	N	N	N	N	N	N	Y	N	N
25	65	F	unk	N			Y	Y	Y	Y	Y	N	Y	N	Y	N	Y	Y	Y	N
28	62	M	unk	N			Y	Y	N	Y	N	Y	Y	N	Y	Y	Y	N	Y	N
30	17	M	10:00 PM	N			N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N
34	40	M	unk	N			Y	Y	N	N	N	Y	Y	N	Y	Y	Y	N	Y	Y
35	35	F	unk	N			Y	Y	Y	N	N	Y	Y	N	Y	Y	N	N	Y	N
37	36	M	unk	N			Y	N	Y	Y	N	Y	Y	N	Y	N	N	N	Y	N
41	54	F	unk	N			Y	Y	Y	N	N	Y	N	N	Y	N	Y	N	Y	N
45	20	M	10:00 PM	N			N	N	N	N	N	N	N	N	N	N	Y	Y	Y	N
46	17	M	unk	N			Y	Y	Y	N	N	Y	N	N	N	Y	N	Y	Y	N
50	9	F	unk	N			N	N	N	N	N	N	N	N	N	N	Y	N	Y	N
51	50	M	unk	N			Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N
53	35	F	unk	N			N	N	N	N	N	N	N	N	N	N	N	Y	Y	N
56	11	F	unk	N			N	N	N	N	N	N	N	N	N	N	N	N	Y	N
61	37	M	unk	N			N	N	N	N	N	N	N	N	N	N	N	N	Y	N
62	24	F	unk	N			Y	Y	Y	N	N	Y	N	N	Y	N	N	N	N	N
63	69	F	unk	N			N	Y	Y	N	Y	N	Y	N	N	Y	Y	N	Y	N
64	7	M	unk	N			Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	N	Y	N
67	11	F	7:30 PM	N			Y	Y	Y	Y	N	Y	N	N	Y	Y	N	N	Y	N
68	17	M	7:30 PM	N			Y	Y	Y	Y	N	Y	N	N	Y	N	Y	Y	N	N
69	36	F	unk	N			N	N	N	N	N	N	N	N	N	N	N	N	Y	N
73	14	F	10:00 PM	N			N	N	N	N	N	N	N	N	N	N	Y	Y	N	N

PART IV - CONCLUSION

The following is quoted verbatim from the report prepared by Dr. Rubin:

"The ice cream was prepared by the Petrie sisters as follows:

"On the afternoon of April 17 raw milk from the Petrie farm at Lycoming was brought to boil over a water bath, sugar and eggs were then added and a little flour to add body to the mix. The chocolate and vanilla ice cream were prepared separately. Hershey's chocolate was necessarily added to the chocolate mix. At 6 p.m. the two mixes were taken in covered containers to the church basement and allowed to stand overnight. They were presumably not touched by anyone during this period.

"On the morning of April 18, Mr. Coe added five ounces of vanilla and two cans of condensed milk to the vanilla mix, and three ounces of vanilla and one can of condensed milk to the chocolate mix. Then the vanilla ice cream was transferred to a freezing can and placed in an electrical freezer for 20 minutes, after which the vanilla ice cream was removed from the freezer can and packed into another can which had been previously washed with boiling water. Then the chocolate mix was put into the freezer can which had been rinsed out with tap water and allowed to freeze for 20 minutes. At the conclusion of this both cans were covered and placed in large wooden receptacles which were packed with ice. As noted, the chocolate ice cream remained in the one freezer can.

"All handlers of the ice cream were examined. No external lesions or upper respiratory infections were noted. Nose and throat cultures were taken from two individuals who prepared the ice cream.

"Bacteriological examinations were made by the Division of Laboratories and Research, Albany, on both ice creams. Their report is as follows: 'Large numbers of *Staphylococcus aureus* and *albus* were found in the specimen of vanilla ice cream. Only a few staphylococci were demonstrated in the chocolate ice cream.'

"Report of the nose and throat cultures of the Petries who prepared the ice cream read as follows: '*Staphylococcus aureus* and hemolytic streptococci were isolated from nose culture and *Staphylococcus albus* from throat culture of Grace Petrie. *Staphylococcus albus* was isolated from the nose culture of Marian Petrie. The hemolytic streptococci were not of the type usually associated with infections in man.'

"Discussion as to Source: The source of bacterial contamination of the vanilla ice cream is not clear. Whatever the method of the introduction of the staphylococci, it appears reasonable to assume it must have occurred between the evening of April 17 and the morning of April 18. No reason for contamination peculiar to the vanilla ice cream is known.

"In dispensing the ice creams, the same scooper was used. It is therefore not unlikely to assume that some contamination to the chocolate ice cream occurred in this way. This would appear to be the most plausible explanation for the illness in the three individuals who did not eat the vanilla ice cream.

"Control Measures: On May 19, all remaining ice cream was condemned. All other food at the church supper had been consumed.

"Conclusions: An attack of gastroenteritis occurred following a church supper at Lycoming. The cause of the outbreak was contaminated vanilla ice cream. The method of contamination of ice cream is not clearly understood. Whether the positive *Staphylococcus* nose and throat cultures occurring in the Petrie family had anything to do with the contamination is a matter of conjecture."

Note: Patient #52 was a child who while watching the freezing procedure was given a dish of vanilla ice cream at 11:00 a.m. on April 18.

Addendum:
Certain laboratory techniques not available at the time of this investigation might prove very useful in the analysis of a similar epidemic today. These are phage typing, which can be done at CDC, and identification of staphylococcal enterotoxin in food by immuno-diffusion or by enzyme-linked immunosorbent assay (ELISA), which is available through the Food and Drug

Administration (FDA).

One would expect the phage types of staphylococci isolated from Grace Petrie's nose and the vanilla ice cream and vomitus or stool samples from ill persons associated with the church supper to be identical had she been the source of contamination. Distinctly different phage types would mitigate against her as the source (although differences might be observed as a chance phenomenon of sampling error) and suggest the need for further investigation, such as cultures of others who might have been in contact with the ice cream in preparation or consideration of the possibility that contamination occurred from using a cow with mastitis and that the only milk boiled was that used to prepare chocolate ice cream. If the contaminated food had been heated sufficiently to destroy staphylococcal organisms but not toxin, analysis for toxin (with the addition of urea) would still permit detection of the cause of the epidemic. A Gram stain might also detect the presence of nonviable staphylococci in contaminated food.

Reference

Gross MB. Oswego County revisited. *Public Health Reports* 1976;91:160-70.